Using Spoken Language to Facilitate Military Transportation Planning

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ABSTRACT

The DARPA SLS Program is developing a technology that has been justified, at least in part, by its potential relevance to military applications. In an effort to demonstrate the relevance of SLS technology to real-world military applications, BBN has undertaken the task of providing a spoken language interface to DART, a system for military logistical transportation planning.

We discuss the transportation planning process, describe the real-world DART system, identify parts of the system where spoken language can facilitate planning, and describe BBN's work towards porting the HARC SLS system to the DART domain.

TRANSPORTATION PLANNING

Logistical transportation planning is the process of determining how to get people and cargo from where they are to where they need to be. Inter-theatre movements of personnel and supplies around the world are currently planned for the Army, Navy, Air Force, and other services by USTRANSCOM (the US TRANSportation COMmand) which operates under the Joint Chiefs of Staff. The transportation planning process is quite complex, involving very large databases of movement requirements, and information about personnel, cargo, transportation assets, and geographic locations. Currently, the human interface to military planning systems is relatively cumbersome and unintelligent, which adds extra complexity to the planner's task.

As a domain for the application of spoken language, military transportation planning has a number of advantages:

1. Transportation planning is an essential military function and successful application of spoken language would be both useful to TRANSCOM and visible to other potential military users of SLS technology.

2. The concept of planning movements of people and supplies can be understood by a wide audience.

3. The application is non-trivial and, in the DART context that we will describe, affords opportunities for applying spoken language understanding at many levels of sophistication.

4. Current efforts to improve the planning process using non-speech technology have been well-received, and cooperative users may be available as close as Scott Air Force Base near St. Louis.

5. An unclassified development database is available in Oracle on a Sun.

THE DART SYSTEM

BBN is currently involved in an effort to improve the transportation process using non-speech technology. The DART (Dynamic Analysis and Replanning Tool) project[1], is demonstrating the operational impact of AI planning and scheduling technology on transportation planning at USTRANSCOM. DART addresses an urgent need for fast and accurate plan generation and evaluation to support both long-range, hypothetical planning and planning in such crisis-response operations as those in the Middle East.

The current DART system [1] is in use at Scott Air Force Base and other locations around the globe. The workstation environment which has been installed at TRANSCOM to support DART is already being used and has been credited with reducing routine plan analysis from 3 days to 1 day [2].

The architecture of the DART system is shown in figure 1. The heart of the system is a relational database. The database is initialized with data from two sources, a database of transportation characteristics, and a Time Phased Force Deployment Database (TPFDD). TPFDDs are usually prepared in advance to deal with hypothetical military operations. In a crisis situation, the planner's task is usually to retrieve an applicable TPFDD, and to change it to fit that new situation. The output of the process is a modified TPFDD which can be used in subsequent planning and operational activities.

A typical TPFDD may contain hundreds of fields and hundreds of megabytes of data, but its focal point will always be a table of *movement requirements* with perhaps thousands of records describing the movement of all the *units* necessary to execute a plan. The planned movement of a unit, which may be as small as a single person or larger than a battalion, consists of three segments. In the first segment, a unit moves from its origin to a Port of Embarkation, or P.O.E. In the second segment, transportation is provided from the POE to a Port of Debarkation, or P.O.D. In the third segment, a unit moves from the POD to its final destination. The POEs and PODs may be airports, sea ports, Air Force bases, or other kinds of locations. The transportation from POE to POD may be by land, sea, or air. This transportation segment is usually of most interest to TRANSCOM planners.

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[1] DART is sponsored by DARPA and Rome Laboratory and involves BBN, Ascent Technologies, ISX Corporation, MITRE Corporation, and SRA Corporation.

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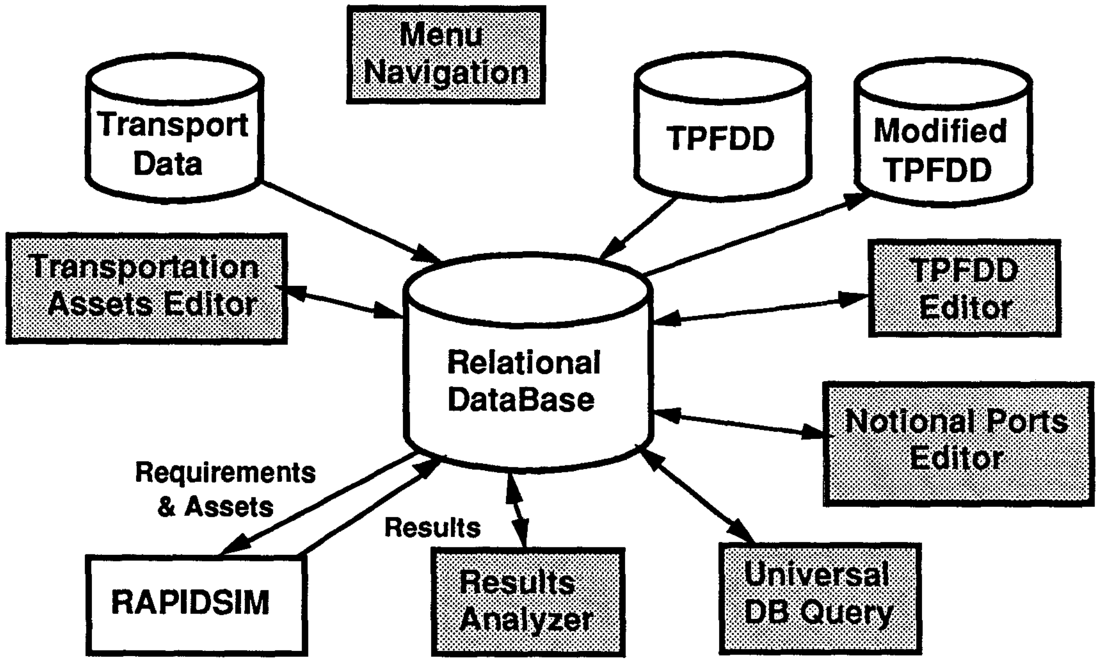

Figure 1: Architecture of DART. Shaded modules are candidates for spoken language interfaces.

DART makes a number of tools available to the planner. These include a TPFDD editor for viewing units and making changes in their characteristics and transportation plans, a notional ports editor which allows ports to be combined for purposes of planning and simulation, a transportation assets editor which lets the planner modify the availability and characteristics of various transportation assets, the RAPIDSIM simulation system which can "run the current plan", and an analysis capability that enables the planner to examine the output of a RAPIDSIM run to determine whether or not the objectives were achieved

DART allows a planner to extract pieces of pre-planned movement records from a database by specifying simple constraints on up to five items: the units to be moved (a unit generally contains both personnel and cargo), the place of origin of the units, their port of embarkation, their port of debarkation, and their final destination.

The retrieved data is displayed in a spreadsheet-like window, horizontal bars showing the number of days each step of the transport is expected to take, with the color indicating whether the step is by land, sea, etc. An example of this window, and other parts of the normal DART display, is given in figure 2.

The TPFDD Database

The database that underlies the entire planning process is called the TPFDD (Time Phased Force Deployment Database) [3]. The TPFDD development database that is unclassified and available in Oracle has 50-100 MB of data, in 13 tables and about 500 fields. This data represents approximately 20,000 cargo movement records, 9,000 unit movement records, and a smaller number of personnel movement records. Each movement record contains, among other information:

- location of origin
- POE (port of embarkation)
- intermediate locations, if any
- tránsportation mode (land, sea, air)
- transportation provider
- POD (port of debarkation/discharge)
- location of destination
- RLD (ready to load date) at origin
- ALD (available to load date) at POE
- EAD (earliest arrival date`) at POD
- LAD (latest arrival date) at POD
- RDD (required delivery date) at destination

DART PLUS SLS

Natural language access (both spoken and typed) increases the utility of the DART interface by providing capabilities that are not available in the non-language interface, and it can decrease the task completion time for operations that can be expressed more concisely in words than in mouse actions.

We have identified six areas of the DART system where natural language will provide increased functionality for this military system:

1. the TPFDD editor, which allows users to create and modify entries in the Timed Phased Force Deployment Databases

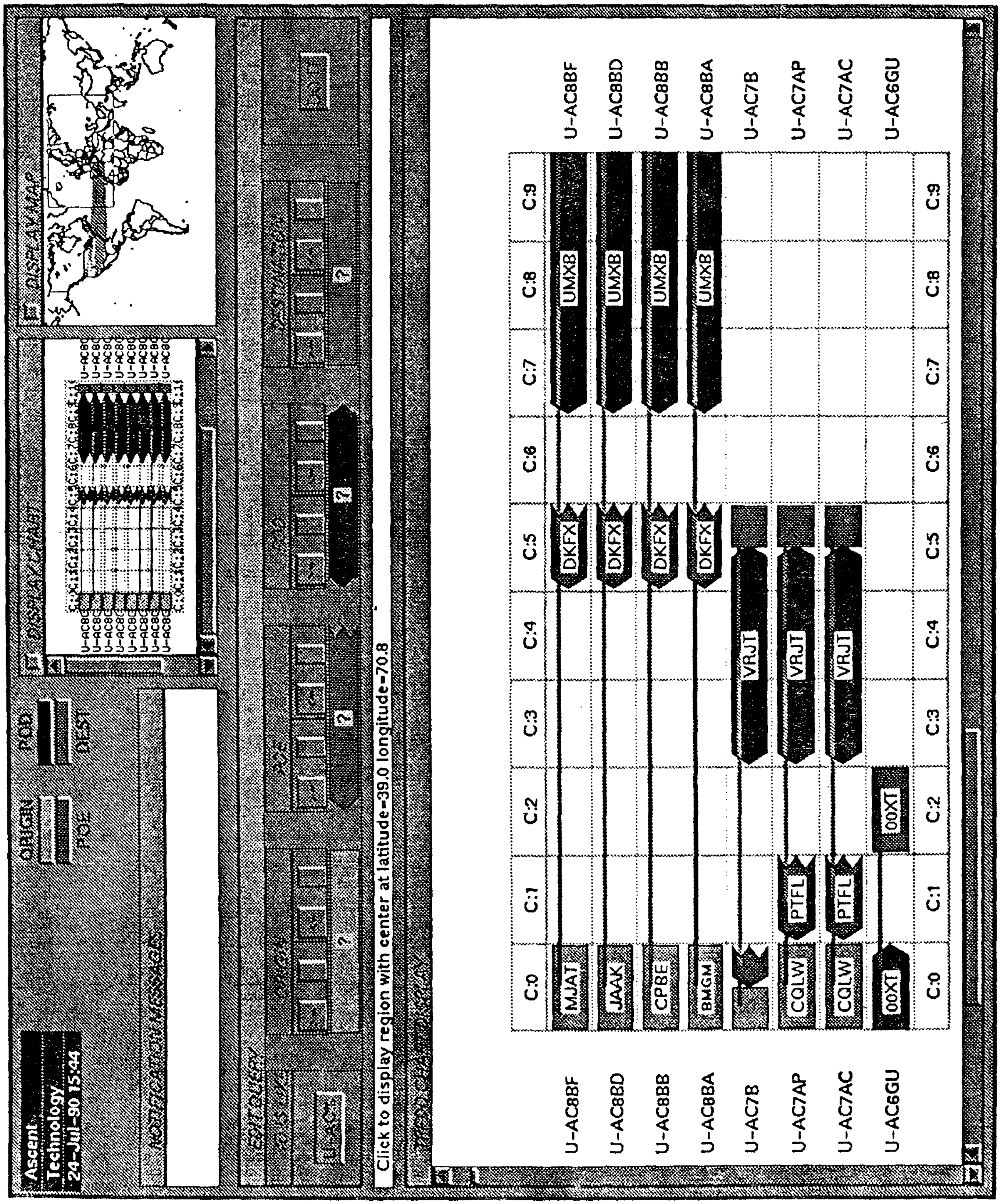

Figure 2: The DART User Interface

that specify movement requirements for the personnel and materiel involved in planned military operations,

2. the transportation assets editor, which is used to view and change the number and type of transportation assets (ships, planes, etc.) and the days when they are available,

3. the notional ports editor, which is used to combine actual ports (sea ports, air ports, or other geographical locations) into single "notional" ports to simplify subsequent simulations of planned movements,

4. the analysis of results from the RAPIDSIM simulation of the current plan's execution,

5. universal (that is, available throughout the whole DART system) access to information in the TPFDD database that underlies the planning system,

6. menu navigation through the DART system, so that a user can use a single verbal command instead of a lengthy sequence of mouse (and possibly keyboard) operations.

Each of these opportunities for adding spoken language to the DART interface has separate pros and cons. They vary in expected vocabulary size, likely language complexity, ease of interface to DART, and utility for the user.

For example, in the notional ports editor, the user is likely to want to give short commands to the system ("Show me Travis Air Force Base", "Zoom in around Charleston", "What's this port?", "Show the nearest military airport", "Compute the notional port assignments"). The planner is also likely to refer only to the geographical locations that are displayed on the current map, which reduces the vocabulary (and the perplexity) considerably.

Universal database query, on the other hand, will involve complex language ("What percentage of the Navy units headed for air force bases in Tunisia that are available to load from US ports prior to day 20 contain hazardous cargo?"). This part of the application will also require a very large vocabulary, since virtually any geographic location or other word from the database can be used in a query. We estimate that even for just a good demonstration, the vocabulary will need to be about 5000 words.

For our initial demonstration, however, we chose to illustrate a database query system because such a system would be very useful and also because its simple interface to DART allowed us to minimize interference with DART development.

Current Status

The videotape presentation describes the task of TRANSCOM planners, shows examples of the current interactions that are possible with DART plus SLS, and shows examples of natural language interactions that will facilitate the planners' work.

As of the time of this workshop, we have transferred from the small in-core planning database that we developed for demonstrating HARC to using the real TRANSCOM development database in Oracle. We have developed an initial DART interface that uses windows to indicate activities in speech processing and NL understanding. We have implemented a mechanism to allow units that are retrieved via natural language queries to be imported into the DART plan display.

Future Work

Future developments will include extending the configuration and vocabulary to cover a larger segment of the database, and to allow voice commands to be executed in the DART system.

REFERENCES

1. Grider, T., Mosley, H., Snow, J., and Wilson, W., "Users Manual for the Dynamic Analytical Replanning Tool (DRAFT)", prepared for BBN by Systems Research and Applications Corporation, 9 November 1990.

2. Edward Walker, personal communication.

3. "Joint Operation Planning System (JOPS) Time Phased Force Deployment Data (TPFDD) and Related Files, Database Specification", System Planning Manual, SPM D5 143-87, Joint Data Systems Support Center, 1 April 1987.